INFORMATION PROCESSING AND ITS IMPLICATIONS TO TEACHING AND LEARNING

by

Assoc. Prof. Azizi Yahaya

Universiti Technology Malaysia

1.0 Abstract

Learning depends on thinking. The more we can understand what happens when we think, the more we can help other people to think "better", differently or in new ways and the more chance we have of being able to help people to learn more efficiently. In the past there has been a growing acceptance that we cannot just ignore thinking simply because we cannot see it happening. Rather, we need to understand what happens when people think and, in the context of educational psychology, try to find ways of helping them to think in ways which will help them to learn more efficiently and easily.

Benjamin Bloom (1956) attempt to categorise the different sorts of intellectual knowledge that teachers wanted their students to learn. Bloom's "taxonomy" as it became known, is still the most useful framework for teachers to use in deciding what it is they are trying to teach their students. Bloom classified knowledge into six categories, ranging from the type of task which demanded the lowest level of thinking (memorization), to the highest level of intellectual ability (evaluation).

Cognitive psychologists have tried to understand what happens when we think and learn. They have constructed models to represent what occurs during the process of thinking. In some cases they have carried out computer simulations of what happens when people attend to new information, incorporate it into what they already know, make sense of the totality of the information which they now possess, memorize this new understanding, and retrieve and use the information some time later.

2.0 Introduction

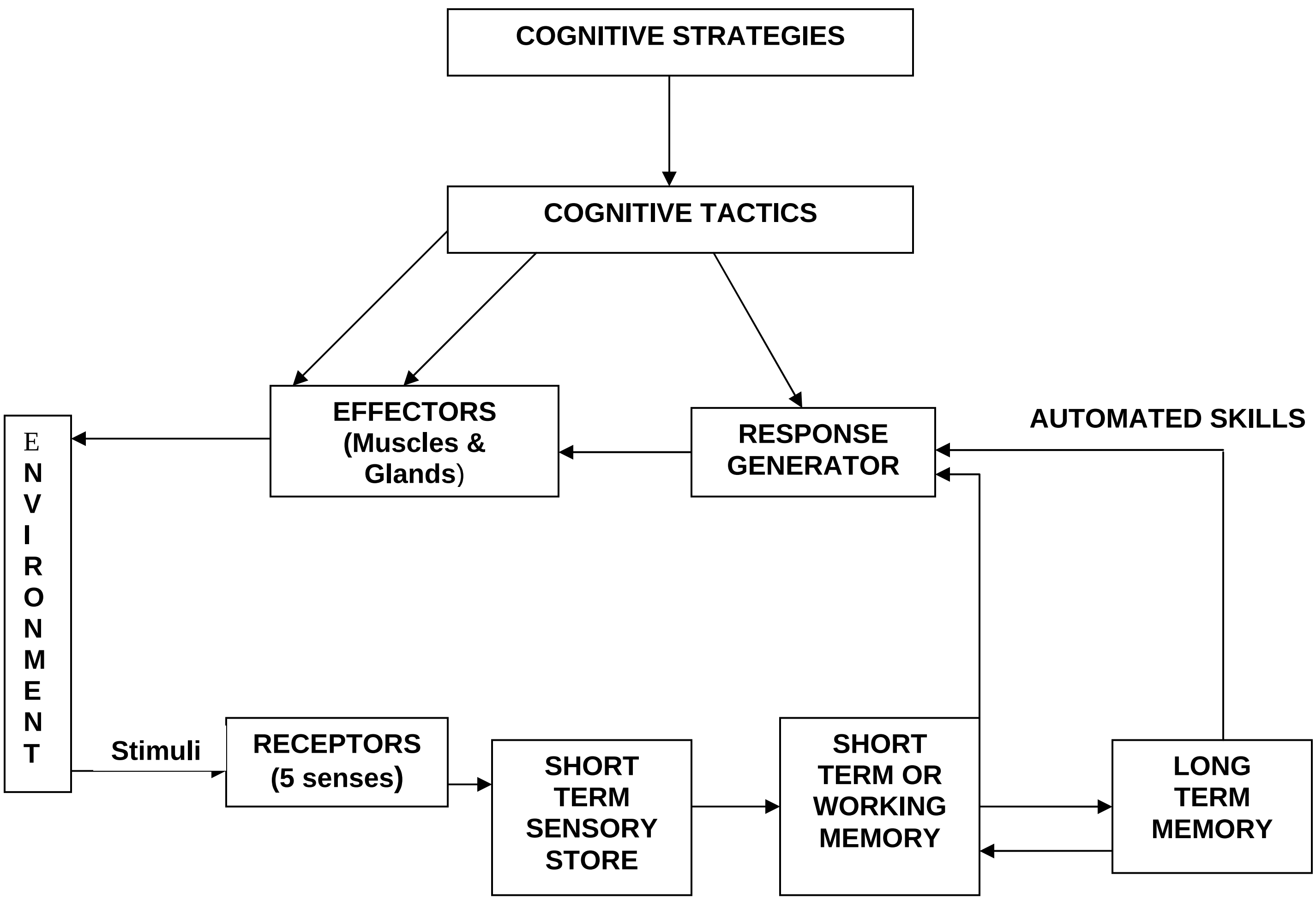
In this article we will examine closely the structures of the information processing model; to understand how each of the structures work; and to find links on how cognitive strategies and tactics influence the efficiency of learning. Learning is a long life process. Teachers want their students to learn all sorts of things. Sometimes they want them to remember information or definitions. Sometimes they want them to learn how to use formulae to solve problems or how to use all sorts of equipment, ranging from computers to hammers.

Quite often than not teachers will tell their students how to become better " thinkers" in order to become capable of distinguishing facts from opinions, logical argument from prejudiced cant, to be critically aware of how the media, advertising agencies and politicians try to influence the way we think.

The "Information-processing Model" represents what happens when information flows through various internal structures which are supposed to exist inside the learner. Presumably these structures represent the functioning of the central nervous system (the brain and the spinal cord). It is important to note that these structures are, at the moment, hypothetical. That is, they have not yet been related to particular locations in the brain. Gagne et al. (1984) have concluded that *some of the processes used by the system may be performed better or faster by some people than by others, but the nature of the system is the same."*

By having a good understanding of the how information is processed, stored and retrieved through the information model, students would be able to learn much more efficiently and systematically as compared to the time when they were at one time ignorant of it.

3.0 THE INFORMATION-PROCESSING MODEL



According to Gagne et.al (1993), when we attempt to comprehend memories and retrieve information, simulation from the environment activates the receptors. All the information from the environment is transferred to the short-term sensory store for two functions. First of all, it filters out unimportant background information and attends to important information by the process of selective perception. In this respect although what one person regards as “important” may be different to another person’s interpretation, so different people may remember different things after reading the same book, seeing the same movie or listening to the same lecture. Secondly, it “makes sense of” the various patterns of stimulation impinging on it. For example, a series of sounds of fluctuating frequencies and amplitudes is: heard” as speech; different colours and intensities of light entering the eye are decoded by the short-term sensory store and we “see” objects.

According to George Miller (1956), the information which is attended to is transferred to the short-term or working memory, where it can remain active for up to about 15-20 seconds without rehearsal. Information in the short-term memory is what we are conscious of at any particular time. To memories this information for longer than 20 seconds requires that the information be rehearsed in a number of forms, for instance, as a visual image or in an articulatory form. George Milller (1956) also mentions that the Short-Term Memory has a limit of 7 +/-2 items. This capacity can be increased by chunking. This is because chunking places input into subsets that are remembered as single units. When this technique is applied to learning, the learner will need to break parts into subparts and process one at a time. They will also need to practice these skills until they are automatic.

Gage and Berliner (1984), maintain that if the simulation in the environment requires an immediate response, the information is passed to the response generator. If the information is to be stored for later use, for example, information given in a lecture, or when someone decides which groceries are to be bought at a shop, the information is encoded and passed into the Long-Term Memory. The Long- Term Memory is thought to have unlimited capacity and duration. From the learning point of view, this encoding is the most critical step. Exactly how material is stored in the long-term memory is not yet precisely known. It is thought that an individual’s cognitive tactics which are highly idiosyncratic determine the form of storage. Some possibilities are in the form of pictures, tables, diagrams or graphs, as meaningful propositions, as mnemonics or in hierarchical arrangement of concepts.

When information which has been encoded and stored is needed by the learner, the long-term memory can be searched and information in it retrieved and transferred to the short-term memory, which can be thought of as our consciousness. In certain cases, automatised skills are transferred directly from the long-term memory to the response generator, such as the skills used in driving which are performed automatically by experienced drivers without consciously thinking about them.

The response generator determines how a person will respond to a particular situation, for example, by speech, action, inaction. It also determines the sequence and timing of the response behaviours. The effectors (muscles and glands) put the responses into effect. The environment provides feedback on the correctness or the appropriateness of the response. Positive feedback serves to “fix the learning.”

According to Berliner (1985), Information processing involves students actively processing, storing and retrieving information from the Long-Term Memory Teaching involves helping learners to develop information processing skills and to apply them systematically to mastering the curriculum. Gagne (1977) maintains that different individuals attend to learn, store and retrieve information in different ways. This is thought to be a reflection of their cognitive strategies and tactics. The arrows leading from the cognitive tactics are not connected to other structures in the model. This indicates that they are capable of effecting any or all of the phases of information processing. Actually, we have the ability to influence each stage of the process and can use a number of techniques to improve the flow of information and improve our ability to understand and memorise information which we may need at a later time. These techniques are known as cognitive tactics. For example, when you’re studying for an exam, you might refer to previous exam papers to find out what sort of questions have been asked in the past. This helps you to identify what information you will need to know. It also indicates what you will be asked to do with the memorised information. For instance, will you simply be asked to regurgitate it or will you be asked to describe how you would use the information in some way. Looking up old exam papers for this matter is an example of a cognitive tactic.

Having identified what you will need to know, you will then read your notes or consult articles or books and take down notes. Different people take notes in different ways. Some people note down exactly what the book says. Others put it into their own words. You will then memorise the information and then use a particular technique to do so. For example, you might use rote-learning or you could use mnemonics. You might practice writing answers to old exam questions. These are also examples of cognitive tactics. We are applying our cognitive strategy when using all of these tactics together when studying for an exam.
A cognitive strategy is, therefore a combination of a number of cognitive tactics.

The cognitive strategies guide learners' behaviours when attending, thinking and memorizing, to choose which cognitive strategies and tactics are to be used at any particular time. Unfortunately according to Biggs, J (1988), not every cognitive tactic is suitable for every learning task. For instance, there are still things which should be rote learned (learned off by heart). For example, it is still important to know your multiplication tables so you can swiftly check that you haven't accidentally press the wrong key on your calculator. When using a word processor, you really need to learn some commands off by heart so you don't have to continually look at the manual to find how to perform simple functions. If you were to study for some multi-choice exams, you might want to learn some definitions or statistics off by heart. So rote learning might be appropriate in these situations.

But if you were studying for the Cognitive psychology paper at the end of this paper, rote learning would not be a very sensible technique to use because the exam will aimed at assessing whether you have understood the various models and theories, whether you can use them to analyse situations, or whether you can use them to improve learning in a practical situation. Therefore it is not enough to simply know how to use cognitive tactics alone, enough to simply know how to use cognitive tactics alone. You also need to able to choose which tactics to use in a particular situation. That is you need to act metacognitively to control your learning behaviour. A metacognitive learner will always self-monitor his/her own learning strategies. After choosing which cognitive tactic to use, the learner need to ": stand outside himself/herself" while learning and monitor whether his/her tactic is, actually working. If his/her learning tactic is found to be not efficient, he/she would modify or consider changing and trying something else.

Poor learners are either unaware of how to use cognitive tactics and strategies or, although they are aware of them, they do not use them or don't use them correctly. Therefore, the best course of action for teachers and lecturers alike is to teach their students how to use cognitive tactics metacognitively. Biggs, J (1988) and Schoenfeld (1987), have some sensible ideas on how this can be accomplished. Biggs, J (1988) and Schoenfield (1987) both agreed that to develop these skills and to become proficient in using it takes time. They also acknowledge that while it is reasonably easy to persuade poor learners that they will benefit from these learning skills, since they are aware that they need to improve, it is more difficult to motivate average learners to change their study habits since they are "getting by" with techniques they already use. Interestingly, gifted learners, like poor learners seems to be more willing to try these new ideas since they can help them learn even more effectively than they do at present.

According to Biggs, J (1988), teachers can incorporate various techniques into their teaching which can help students with inadequate tactics and strategies.

The techniques can be used to improve students' motivation, selective perception, understanding, encoding, retrieval and problem solving.

When learning something, it is important that we know what we are learning it for. What do we want to be able to do with the information or skill we're learning? “Good” learners, those who are metacognitively in control of their own learning, will try to ensure that they target their learning so that they know how they will be expected to use knowledge or skill. They also make a conscious effort to link the new material with other material they have already learned. Both these cognitive tactics serve not only to make learning easier but also tend to increase the motivation of the learner who now has a clear goal in mind and also has a number of related concepts to which the new material can be linked. To enhance the motivation of students who do not use these tactics, the teacher can provide them with an advance organiser which can help students to recall related concepts or ideas. On the other hand, the teacher can help students to identify their learning goals and objectives. This helps students to know what it is he or she is expected to learn and when learning is complete.

Biggs, J (1988) further maintains that “ Good” learners are able to pick out what are the most important things to learn in a topic or subject by using selective perception, a process which occurs in the short-term sensory store. “Good” learners are able to extract the central elements from a lecture or books or from lecture notes and filter out the less important details. Poor learners on the other hand will tend to have difficulty in doing this, and end up trying to learn everything or take notes on everything, or, even worse, take note on unimportant elements and miss some of the central issues and their implications.

According to Biggs, J (1988), understanding is another essential element in most learning. It is not enough to select information which needs to be known, try to simplify them, and then learn them off by heart. When learning new information it is important to understand how this information can be used. “Good” learners, according to Biggs, make sure that they know how to use information and know when and how to use it. Poor learners often seem to think that it is sufficient to learn information off by heart without making an effort to see its implication. Teachers can help students to understand new information by making sure that they see how it can be applied. In other words, rather than just presenting new information in abstract or theoretical form, teachers should make sure that learners are given the opportunity to use the information, preferably in a practical setting or at least in a simulated setting. For example, if a teacher introduces the concept of area to a class, then, as well as doing textbook examples, students should be encouraged to measure the area of the classroom, playground, their bedrooms and so forth so they may understand how the concept works and relates to everyday life. Teachers as well as getting their students to use the information in practical activities, can also encourage them to question their acceptance and understanding of the information learned.

According to Gage & Berliner (1984), memorising information and remembering how to apply skills is one of the major tasks of learning. Learning something one night according to Gage & Berliner is of little use if it cannot be remembered at some later time. Gage & Berliner opined that metacognitive learners are able to devise cognitive tactics or techniques to help them to remember something and to recall it easily at a later date. This process according to Gage & Berliner is known as encoding. Teachers can help their students encode information for easy retrieval in two ways. Firstly by providing the learner with the information already coded in the form of mnemonics, graphs, tables, propositions and so forth. Better still, encourage the learner to construct his/her own code. This helps the learner in storing information in his/her long-term memory in easily remembered form. Secondly teachers can provide learners with cues to trigger the coded information. This helps the learner to recall information stored in his/her long-term memory in a coded form.

Gage & Berliner (1984) also suggest that problem solving skills are crucially desired to enhance learning. Teachers can help students to acquire better problem-solving cognitive tactics by making sure that they spend time in clarifying the goal of the problem; that is; being absolutely sure that they understand what the solution of the problem is to achieve. Having done so, teachers should encourage students to brainstorm a number of possible approaches to solving the problem before trying one approach. Along the line teachers should make students stop at intervals to check that the approach they are trying is making progress in moving towards a solution.

4.0 Conclusion

Effective learning depends very much on our ability to understand how the information processing model works because it represents what happens when information flows through various internal structures which are supposed to exist inside the learner. It is also important to note that we do actually the ability to influence each stage of the process and can use a number of techniques to improve the flow of information and improve our ability to understand and memorise information which we may need at a later time. Thus, one of the most important things we all need to understand is the role of our metacognition to control our learning behaviours. Finally, teachers should incorporate various techniques into their teachings in order to improve students' motivation, selective perception, understanding, encoding, retrievals and problem solving.

References

Bloom, B. (1984). **The Search for methods of group instructions as effective as one-to-one tutoring.** Educational Leadership

Gagne, R (1970). **The Conditions of Learning (Second Edition*).*** New York: Holt, Rinehart, & Winston Holt

Gage & Berliner (1984). **Educational Psychology**

Gagne, E.D., Yekovich, C. W., & Yekovich, F.R (1993). **The Cognitive Psychology of School Learning.**

Good, T.E and Brophy J.E (1986). **Educational Psychology**. Third Edition. Longman Publishing, New York 1986

Hilgard, E.R and Bower, G.H (1975). **Theories of Learning. Fourth Edition.** Prentice-Hall, Inc. Englewood Cliffs, NJ 1975.